An Investigation of

THE RECOVERY OF GOLD

FROM AURIFEROUS SULPHIDE ORES AND CONCENTRATES

- NOVA SCOTIA MDA

submitted by

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Note:

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LAKEFIELD RESEARCH
A Division of Falconbridge Limited

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EXECUTIVE SUMMARY

Most of the gold in the sample as received was coarse free gold. There were great variations between the assay heads and calculated heads. The average calculated head assay obtained from the 38 kilograms of test charges was 7.85 g/t Au.

The evidence from flotation, gravity concentration, cyanidation and amalgamation indicated that there was little gold associated or inclusive in the arsenic and sulphide minerals. Arsenopyrite was the only arsenic mineral identified and represented approximately 1% of the sample. 98% of the gold and 97% of the arsenic were recovered in the flotation rougher concentrate which assayed 21.7 g/t Au and 2.44 % As. With three cleaning stages, 86.4 % of the gold and 10.7 % of the arsenic were recovered in the cleaner concentrate which assayed 131 g/t Au and 1.83 % As.

At a grind of 45 - 67 % minus 200 mesh, 86% to 90% of the gold was recovered by two stage gravity concentration in a concentrate which weighed 0.03 - 0.2 % of the head and assayed 29191 g/t Au - 3505 g/t Au. The remaining gold could be recovered by subsequent flotation (or other methods). Total gold recovered by gravity concentration and flotation was 98%.

INTRODUCTION

This testwork was conducted under contract Serial No. OSQ85-00345 of Department of Supply and Services, Canada. The DSS file No. is 04SQ.23440-5-9265.

The objective of this preliminary investigation was to examine the mineral species in the head sample and to recover the gold by gravity concentration and flotation. Depending on the test results, further investigative program would be designed and conducted.

LAKEFIELD RESEARCH

R.S. Salter

Manager.

W.T. Yen, Ph.D.,

Senior Project Engineer.

Experimental Work by: J. McCarthy

G. Ashford

TECHNICAL RESULTS AND DISCUSSION

1. Head Assay

The head sample assay is shown in Table No. 1 and its qualitative spectrographic analysis in Table No. 2. Two split head samples were duplicate assayed for gold. The first assay was 2.98 g/t Au and 2.45 g/t Au. The second assay was 11.8 g/t Au and 7.41 g/t Au. The average gold assay was 6.16 g/t Au. The great variation in gold head assay was due to the presence of coarse free gold.

The average calculated head assay from the first 9 tests (total 18 kg) was 5.72 g/t Au. The calculated head from a 20 kg test was 9.76 g/t Au.

Table No. 1. Head Sample Assay

Au (g/t)	6.16
Ag (g/t)	1.7
Fe (%)	5.02
As (%)	0.57
S (%)	0.82
C(%)	0.57

Table No. 2. Qualitative Spectrographic Analysis of Head Sample

Range of Percentage	Element
10 - 100 %	Si
3 - 30 %	Fe
1 - 10 %	Al, Mg, Ca
0.3 - 3 %	Na
0.1 - 1 %	As
0.03 - 0.3 %	Ti
1 - 0.1 %	Mn, K, Cr, Ba
0.003 - 0.03 %	Cu, Zr
0.001 - 0.01 %	V, Zn, B, Pb, Ga, Ni, Co
0.0003 - 0.003 %	Ag
0.0001 - 0.001 %	-
< 0.0003 %	Bi

Technical Results and Discussion - Cont'd

2. Mineralogical Examination

A minus 10 mesh head sample was submitted for examination with special emphasis on identification and amount present of the arsenic minerals. The opaque minerals identified were arsenopyrite, pyrrhotite, pyrite, marcasite, galena and metallic silver. Arsenopyrite was the only arsenic mineral identified and represented approximately 1 percent by weight of the sample. Pyrrhotite was slightly more abundant than pyrite and together they represented 1.5 percent by weight of the sample. Galena and silver were present in trace amount only. Gold was not identified.

3. Flotation Test

In the initial testwork, the rougher flotation was conducted with grinds of 65% - 95% minus 200 mesh. Five roughing stages were conducted in each test and each rougher concentrate was separately removed for assay. 25 g/t AX350 and 25 g/t AF208 were used in each stage. The frother MIBC was added as required. Flotation time was 3 minutes in the first stage and 5 minutes per stage in the following stages.

Table No. 3 summarizes the results of the rougher flotation tests. In Test No. 1, the sample was ground to 66.9 % minus 200 mesh, 83.9 % of the gold was recovered in 13 minutes flotation and 97.7 % of the gold recovered in 23 minutes. The final rougher tailing assayed as 0.07 g/t Au,

In Test No. 2, the sample was ground to 84.0 % minus 200 mesh, 94.3 % of the gold was recovered in the first 3 minutes flotation. 98.4 % of the gold was recovered in 23 minutes flotation leaving a tailing which assayed 0.07 g/t Au.

Technical Results and Discussion - Cont'd

Table No.

3. Flotation Test - Cont'd

Test No.

In Test No. 3, the sample was ground to 93.3 minus 200 mesh; 97.3 % of the gold was floated in 8 minutes. Total gold recovery was 98.9 % and the tailing assayed 0.07 % Au.

Each flotation product was also assayed for sulphur and arsenic. The results indicate that there are no close relationships among the gold occurrence, sulphur and the arsenic. With large amounts of sulphur and arsenic in the cleaner concentrate, the gold grade would be greatly diluted.

The above results also show that more than 97% of the gold could be recovered by 15 minutes flotation at the grind of 67% minus 200 mesh.

In order to obtain a high grade gold concentrate, a cleaner flotation test was conducted in Test No. 4. A 2000 gram sample was ground to 67% minus 200 mesh. The rougher flotation was conducted with three 5 minute stages by using 45 g/t AX350, 45 g/t AF208 and 10 g/t MIBC. The rougher concentrate was cleaned three times with a small amount of reagent in the first two cleaners and no reagent in the last cleaner. The results are summarized in Table No. 4. 98.0 % of the gold and 97.3 % of the arsenic were recovered in a rougher concentrate, which weighed 21.12 % of the head and assayed 21.7 g/t Au. The cleaner stage removed the arsenic mineral and upgraded the gold content. The second cleaner, weighed 5.46 % of head and assayed 83.5 g/t Au. 97.3 % of the gold and 38.8 % of the arsenic were recovered. The third cleaner weighed 3.09 % and assayed 131.0 g/t Au with 86.4 % of the gold and 10.7 % of the arsenic recovered. The decrease in gold recovery in the third cleaner may have been due to a lack of collector.

Technical Results and Discussion - Cont'd

Table No. 3. Results of Rougher Flotation

Test No.	Grind % -200 Mesh	Product	Weight %	Assay, g/t, %			% Distribution		
				Au	S	As	Au	S	As
1	66.9	Ro. Conc. 1	2.8	73.0	11.3	9.98	83.9	37.9	54.4
		Ro. Conc. 2	6.7	1.79	5.02	2.84	4.9	40.3	37.0
		Ro. Conc. 3	3.8	5.03	1.77	0.51	7.8	8.1	3.8
		Ro. Conc. 4	5.2	0.33	0.97	0.18	0.7	6.0	1.8
		Ro. Conc. 5	4.1	0.23	0.43	0.11	0.4	2.1	0.9
		Rougher tailing	77.4	0.07	0.06	0.014	2.3	5.6	2.1
		Head (calc.)	100.0	2.44	0.83	0.51	100.0	100.0	100.0
2	84.0	Ro. Conc. 1	7.5	38.2	8.41	8.24	94.3	63.5	91.3
		Ro. Conc. 2	3.9	0.79	2.73	0.47	1.0	10.7	2.7
		Ro. Conc. 3	7.4	0.26	1.60	0.21	0.6	11.9	2.3
		Ro. Conc. 4	5.9	1.09	0.97	0.13	2.1	5.8	1.1
		Ro. Conc. 5	7.7	0.16	0.35	0.079	0.4	2.7	0.9
		Rougher Tailing	67.6	0.07	0.08	0.017	1.6	5.4	1.7
		Head (calc.)	100.0	3.04	0.99	0.68	100.0	100.0	100.0
3	93.3	Ro. Conc. 1	4.1	98.5	4.83	5.24	95.9	23.5	43.0
		Ro. Conc. 2	6.7	0.91	5.52	2.95	1.4	43.9	39.5
		Ro. Conc. 3	8.4	0.32	1.93	0.68	0.6	19.2	11.4
		Ro. Conc. 4	7.6	0.22	0.75	0.16	0.4	6.7	2.4
		Ro. Conc. 5	9.3	0.27	0.26	0.073	0.6	2.9	1.4
		Rougher Tailing	63.9	0.07	0.05	0.018	1.1	3.8	2.3
		Head (calc.)	100.0	4.21	0.84	0.50	100.0	100.0	100.0

Table No. 4. Results of Cleaner Flotation (Test No. 4)

Product	Weight %	Assay, g/t, %			% Distribution		
		Au	As	S	Au	As	S
3rd Cleaner Concentrate	3.09	131.0	1.83	9.37	86.4	10.7	35.5
2nd Cleaner Concentrate	5.46	83.5	3.76	8.76	97.3	38.8	58.7
1st Cleaner Concentrate	9.83	46.5	2.47	5.22	97.5	45.8	63.0
Rougher Concentrate	21.12	21.7	2.44	3.56	98.0	97.3	92.2
Rougher Tailing	78.88	0.12	0.018	0.08	2.0	2.7	7.8
Head	100.00	4.69	0.53	0.81	100.0	100.0	100.0

Technical Results and Discussion - Cont'd

Gravity Concentration and Flotation of Tailing

The sample was ground and the gold was recovered using Wilfley and Mozley tables. The flotation procedure of Test No. 4 was conducted on the gravity separation tailing to recover the remaining gold. Two tests were conducted with a 2 kg sample and one test with a 20 kg sample. The results are summarized in Table 5.

In Test No. 5, a 2000 gram sample was ground to 67% minus 200 mesh and passed over a Wilfley table. 91.2 % of the gold was recovered in the table concentrate which weighed 3.94 % of the head and assayed 187.0 g/t Au. The table tailing was used as head for flotation and cleaned three times. 7.3 % of the gold was recovered in the third cleaner concentrate which weighed 1.89 % of the head and assayed 31.2 g/t Au. The combined concentrates from the table and the third cleaner represented recovery of 98.5 % of the gold and assayed 136.5 g/t Au.

In Test No. 9, a 2000 gram sample was ground to 45 % minus 200 mesh and passed over a Wilfley table. The Wilfley table concentrate was further upgraded on a Mozley table to obtain a concentrate of high grade and small weight. The results show that 86.6 % of the gold was recovered in the Mozley table concentrate which weighed 0.2 % of the head and assayed 3505.0 g/t Au. The tailings from the Wilfley and Mozley tables were combined for flotation and cleaned twice. 12.3 % of the gold was recovered in the second cleaner concentrate which weighed 3.3 % of the head and assayed 30.5 g/t Au. The combined concentrates of the Mozley table and the second cleaner concentrate represented a recovery of 98.9 % of the gold and assayed 228.9 g/t Au.

Technical Results and Discussion - Cont'd

5. Gravity Concentration and Flotation of Tailing - Cont'd

In Test No. 10, a 20 kg sample was ground to 60% minus 200 mesh and passed over a Wilfley table. The table concentrate was upgraded with a Mozley table to obtain a high grade - low weight concentrate. The result shows that 89.7 % of the gold was recovered in the Mozley table concentrate which weighed 0.03 % of the head and assayed 29191 g/t Au. There were several visible coarse native gold particles larger than 1 mm in the table concentrate. Two native gold particles, one of which measured 50 x 70 x 80 mm and weighed about 70 - 80 mg, were cleaned out from the pump. All the native gold particles were included in the Mozley table concentrate for the calculation.

Both the tailing from the Wilfley and Mozley tables were combined for the flotation and cleaned twice. 10.1 % of the gold was recovered in the rougher concentrate which weighed 17.04 % and assayed 5.82 g/t Au. 8.4 % of the gold was recovered in the third cleaner concentrate which weighed 2.64 % and assayed 31.1 g/t Au. The combined concentrates of the Mozley table and the third cleaner concentrate represented recovery of 98.1 % of the gold and assayed 358.7 g/t Au.

Technical Results and Discussion - Cont'd

Gravity Concentration and Flotation of Tailing - Cont'd

Table No.5. Results of Gravity Concentration and Flotation of Tailing

Test No.	Grind % -200 Mesh	Product	Weight %	Assay, g/t, %			% Distribution		
				Au	As	S	Au	As	S
5	67	Wilfley Table Conc.	3.94	187.0	7.21	8.84	91.2	55.7	42.4
		3rd Cleaner Conc.	1.89	31.2	4.6	13.3	7.3	17.1	31.9
		Table + 3rd Cl.Conc.	5.83	136.5	6.36	10.1	98.5	72.8	74.3
		Rougher Conc.	13.90	4.47	1.53	2.91	7.7	41.7	51.3
		Rougher Tailing	82.16	0.11	0.016	0.06	1.1	2.6	6.3
		Head (calc.)	100.00	8.08	0.51	0.79	100.0	100.0	100.0
9	45	Mozley Table Conc.	0.2	3505.0	-	-	86.6	-	-
		2nd Cleaner Conc.	3.3	30.5	-	-	12.3	-	-
		Table + 2nd Cl.Conc.	3.5	228.9	-	-	98.9	-	-
		Rougher Conc.	13.1	7.85	-	-	12.7	-	-
		Rougher Tailing	86.7	0.07	-	-	0.7	-	-
		Head (calc.)	100.0	8.10	-	-	100.0	-	-
10	60	Mozley Table Conc.	0.03	29191.	-	-	89.7	-	-
		3rd Cleaner Conc.	2.64	31.1	-	-	8.4	-	-
		Table + 3rd Cl.Conc.	2.67	358.7	-	-	98.1	-	-
		Rougher Conc.	17.04	5.82	-	-	10.1	-	-
		Rougher Tailing	82.93	0.02	-	-	0.2	-	-
		Head (calc.)	100.00	9.76	-	-	100.0	-	-

Technical Results and Discussion - Cont'd

5. Flotation and Cyanidation of Concentrate

The sample was ground and floated as in Test No. 4. The second cleaner concentrate was filtered and repulped for cyanidation. The objective of this test was to investigate the amenability of the gold extraction from the flotation concentrate by cyanidation.

Table No. 6A shows that 98.8 % of the gold was recovered in the rougher concentrate which assayed 18.1 g/t Au. 85.9 % of the gold was recovered in the second cleaner concentrate which weighed 6.08 % and assayed 54.3 g/t Au, which was cyanided with 1 g/L NaCN at pH 11 in two 24 hour stages. Table No. 6B shows that the gold extraction was 88.6 % in 24 hours and 98.8 % in 48 hours. The reagent consumption for 48 hours cyanidation was 0.66 kg/t NaCN and 3.39 kg/t CaO in terms of the second cleaner concentrate, or 0.04 kg/t NaCN and 0.21 kg/t CaO in terms of the total feed weight. The overall extraction was 84.8 % of the gold. There was 11.4 % of the gold distributed in the second cleaner tailing. If the first cleaner concentrate (included the second cleaner concentrate and tailing) was used for the cyanidation, a 96 % overall gold extraction would be predicted.

Technical Results and Discussion - Cont'd

Flotation and Cyanidation of Concentrate - Cont'd

Table No. 6A. Flotation Result (Test No. 6)

Product	Weight %	Assay, Au, g/t	% Distribution Au
2nd Cleaner Concentrate	6.08	54.3	85.9
1st Cleaner Concentrate	8.69	43.0	97.3
Rougher Concentrate	20.99	18.1	98.8
Rougher Tailing	79.01	0.06	1.2
Head (calculated)	100.00	3.85	100.0

Table No. 6B. Cyanidation Result on the Second Cleaner Concentrate (Test 6)

Stage	NaCN, kg/t*		CaO, kg/t*		Residue Au, g/t	% Au Extraction	
	Added	Cons.	Added	Cons.		Individual	Overall
24 h Cyanidation	2.64	0.58	3.55	2.81	6.22	88.6	76.0
48 h Cyanidation	2.15	0.08	0.66	0.58	0.67	10.2	8.8
Total	4.79	0.60	4.21	3.39	0.67	100.0	84.8

* kg/t of second cleaner concentrate

Technical Results and Discussion - Cont'd

5. Amalgamation and Flotation of Tailing

The purpose of Test No. 8 was to estimate the amount of free gold in the head sample. A 2000 gram sample was ground to 84 % minus 200 mesh and pulped in four bottles. The amalgamation was carried out on rolls for two hours. The amalgamation tailings were combined for flotation and cleaned twice. Table No. 7 shows that 95.6 % of the gold was recovered in the amalgam, which represented the amount of free gold at the grind of 84% minus 200 mesh. The remaining 4.1 % of the gold was associated with sulphide minerals and recovered in the flotation rougher concentrate.

Table No. 7. Results of Amalgamation and Flotation (Test No. 8)

Product	Weight %	Assay Au, g/t	% Distribution Au
Amalgam	-	24.85*	95.6
2nd Cleaner Conc.	4.5	11.3	3.9
Rougher Concentrate	16.5	3.27	4.1
Rougher Tailing	83.5	0.05	0.3
Head (calculated)	100.0	13.1	100.0

* mg of Au

CONCLUSIONS

The sample as received contained a large amount of free gold. The head sample assay ranged from 2.45 g/t Au to 11.8 g/t Au. The average calculated head assay from the first 9 tests (18 kg) was 5.72 g/t Au and from a 20 kg test was 9.76 g/t Au. Thus, the calculated head assay from the testwork averaged 7.85 g/t Au.

The gold and the sulphide minerals could be easily recovered by flotation. At a grind of 60 - 70 % minus 200 mesh, 98 % of the gold and 97% of the arsenic were recovered in a rougher concentrate which assayed 21.7 g/t Au and 2.44 % As. After three cleaning stages, 97.3 % of the gold and 38.8 % of the arsenic were recovered in the second cleaner concentrate which assayed 83.5 g/t Au and 3.76 % As. 86.4 % of the gold and 10.7 % of the arsenic were recovered in the third cleaner concentrate which assayed 131 g/t Au and 1.83 % As. These results indicated that only a small quantity of gold could be associated with arsenic or sulphide minerals. This evidence was further supported by results from gravity concentration, cyanidation and amalgamation testwork.

At a grind of 45 % - 67 % minus 200 mesh, more than 90% of the gold was recovered in a primary gravity concentrate which weighed 3.94 % of the head and assayed 187 g/t Au. After a secondary gravity concentration, 86 % to 90% of the gold was recovered in a final concentrate which weighed 0.03 % - 0.2 % of the head and assayed 29191 g/t Au - 3505 g/t Au.

The result of the cyanidation of the flotation cleaner concentrate showed that the gold extraction was 98.8 % and there was little association with sulphide minerals.

At the grind of 84 % minus 200 mesh, more than 95 % of the gold was recovered by the amalgamation and only 4 % of the gold was subsequently floated along with the arsenic and sulphide minerals.

Conclusions - Continued

In conclusion, the combined flowsheet of gravity concentration and flotation recovered 98% of the gold from the sample provided.

SAMPLE PREPARATION

Approximately 50 kg of sample were received at Lakefield. The sample was crushed to minus 10 mesh and split into two portions. The first portion was used to prepare ten 2 kg test charges and two assay head samples. A 20 kg test charge was prepared from the second portion. All the samples were stored in the refrigerator to prevent the oxidation of sulphide minerals.

DETAILS OF TESTS

Test No. 1

Purpose: To float a series of rougher concentrates using A350 and A208.

Procedure: As outlined below.

Feed: 2000 grams minus 10 mesh.

Grind: 20 minutes at 65% solids in the lab ball mill.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes		pH
	A350	A208	MIBC	Cond.	Froth	
Rougher No. 1	25	25	10	1	3	7.3
Rougher No. 2	25	25	-	1	5	-
Rougher No. 3	25	25	5	1	5	-
Rougher No. 4	25	25	5	1	5	-
Rougher No. 5	25	25	5	1	5	-

Stage: Rougher
Flotation Cell: 1000 g D-1
Speed: r.p.m.: 1800

Test No. 1 - Continued

Metallurgical Results

Product	Weight %	Assays, %, g/t			% Distribution		
		Au	As	S	Au	As	S
1. Rougher Concentrate 1	2.8	73.0	9.98	11.3	83.9	54.4	37.9
2. Rougher Concentrate 2	6.7	1.79	2.84	5.02	4.9	37.0	40.3
3. Rougher Concentrate 3	3.8	5.03	0.51	1.77	7.8	3.8	8.1
4. Rougher Concentrate 4	5.2	0.33	0.18	0.97	0.7	1.8	6.0
5. Rougher Concentrate 5	4.1	0.23	0.11	0.43	0.4	0.9	2.1
6. Rougher Tailing	77.4	0.07	0.014	0.06	2.3	2.1	5.6
Head (calculated)	100.0	2.44	0.51	0.83	100.0	100.0	100.0

Calculated grades and Recoveries

Products 1 plus 2	9.5	22.8	4.94	6.87	88.8	91.4	78.2
Products 1 to 3	13.3	17.7	3.68	5.41	96.6	95.2	86.3
Products 1 to 4	18.5	12.8	2.69	4.16	97.3	97.0	92.3
Products 1 to 5	22.6	10.5	2.23	3.49	97.7	97.9	94.4

Screen Analysis

Combined Products

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	4.6	4.6	95.4
100	7.1	11.7	88.3
150	10.7	22.4	77.6
200	10.7	33.1	66.9
270	9.5	42.6	57.4
400	9.0	51.6	48.4
- 400	48.4	100.0	-
Total	100.0	-	-

Test No. 2

Purpose: As for Test 1, but with a longer grind.

Procedure: As outlined below.

Feed: 2000 grams minus 10 mesh

Grind: 30 minutes at 65% solids in the lab ball mill.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes		pH
	A350	A208	MIBC	Cond.	Froth	
Rougher No. 1	25	25	10	1	3	7.7
Rougher No. 2	25	25	-	1	5	-
Rougher No. 3	25	25	5	1	5	-
Rougher No. 4	25	25	5	1	5	-
Rougher No. 5	25	25	5	1	5	-

Rougher	
Stage	Rougher
Flotation Cell	1000 g D-1
Speed: r.p.m.	1800

Test No. 2 - Continued

Metallurgical Results

Product	Weight %	Assays, %, g/t			% Distribution		
		Au	As	S	Au	As	S
1. Rougher Concentrate 1	7.5	38.2	8.24	8.41	94.3	91.3	63.5
2. Rougher Concentrate 2	3.9	0.79	0.47	2.73	1.0	2.7	10.7
3. Rougher Concentrate 3	7.4	0.26	0.21	1.60	0.6	2.3	11.9
4. Rougher Concentrate 4	5.9	1.09	0.13	0.97	2.1	1.1	5.8
5. Rougher Concentrate 5	7.7	0.16	0.079	0.35	0.4	0.9	2.7
6. Rougher Tailing	67.6	0.07	0.017	0.08	1.6	1.7	5.4
Head (calculated)	100.0	3.04	0.68	0.99	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	11.4	25.4	5.58	6.47	95.3	94.0	74.2
Products 1 to 3	18.8	15.5	3.47	4.55	95.9	96.3	86.1
Products 1 to 4	24.7	12.1	2.67	3.70	98.0	97.4	91.9
Products 1 to 5	32.4	9.23	2.05	2.90	98.4	98.3	94.6

Screen Analysis

Combined Products

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 65	0.1	0.1	99.9
100	1.1	1.2	98.8
150	4.9	6.1	93.9
200	9.9	16.0	84.0
270	12.2	28.2	71.8
400	13.3	41.5	58.5
- 400	58.5	100.0	-
Total	100.0	-	-

Test No. 3

Purpose: As for Test 2, but with a longer grind.

Procedure: As outlined below.

Feed: 2000 grams minus 10 mesh.

Grind: 40 minutes at 65% solids in a lab ball mill.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes	
	A350	A208	MIBC	Cond.	Froth
Rougher No. 1	25	25	10	1	3
Rougher No. 2	25	25	-	1	5
Rougher No. 3	25	25	5	1	5
Rougher No. 4	25	25	5	1	5
Rougher No. 5	25	25	5	1	5

Stage Rougher
Flotation Cell 1000 g D-1
Speed: r.p.m. 1800

Test No. 3 - Continued

Metallurgical Results

Product	Weight %	Assays, %, g/t			% Distribution		
		Au	As	S	Au	As	S
1. Rougher Concentrate 1	4.1	98.5	5.24	4.83	95.9	43.0	23.5
2. Rougher Concentrate 2	6.7	0.91	2.95	5.52	1.4	39.5	43.9
3. Rougher Concentrate 3	8.4	0.32	0.68	1.93	0.6	11.4	19.2
4. Rougher Concentrate 4	7.6	0.22	0.16	0.75	0.4	2.4	6.7
5. Rougher Concentrate 5	9.3	0.27	0.073	0.26	0.6	1.4	2.9
6. Rougher tailing	63.9	0.07	0.018	0.05	1.1	2.3	3.8
Head (calculated)	100.0	4.21	0.50	0.84	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	10.8	38.0	3.82	5.26	97.3	82.5	67.4
Products 1 to 3	19.2	21.5	2.45	3.80	97.9	93.9	86.6
Products 1 to 4	26.8	15.5	1.80	2.94	98.3	96.3	93.3
Products 1 to 5	36.1	11.5	1.35	2.25	98.9	97.7	96.2

Screen Analysis

Combined Products

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	-	-	-
100	0.1	0.1	99.9
150	1.3	1.4	98.6
200	5.3	6.7	93.3
270	10.1	16.8	83.2
400	14.3	31.1	68.9
- 400	68.9	100.0	-
Total	100.0	-	-

Test No. 4

Purpose: To conduct a flotation test with three cleaning stages.

Procedure: Roughing was conducted in three 5 minute stages, followed by three cleaning stages.

Feed: 2000 grams minus 10 mesh

Grind: 20 minutes per 2000 g sample in a laboratory ball mill at 65 % solids.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes	
	AX350	AF208	MIBC	Cond.	Froth
Rougher (1)	20	20	5	1	5
(2)	15	15	-	1	5
(3)	10	10	5	1	5
1st Cleaner	-	-	-	-	5
	10	10	5	1	5
2nd Cleaner	-	-	-	-	4
	5	5	5	1	3
3rd Cleaner	-	-	-	-	5

Stage	Rougher	1st + 2nd Cl.	3rd Cleaner
Flotation Cell	Denver 1000 g D-1	Denver 500 g D-1	Denver 250 g D-1
Speed: r.p.m.	1800	1500	1200

Metallurgical Results

Product	Weight %	Assays, %, g/t			% Distribution		
		Au	As	S	Au	As	S
1. 3rd Cleaner Conc.	3.09	131.0	1.83	9.37	86.4	10.7	35.5
2. 3rd Cleaner Tailing	2.37	21.5	6.29	7.96	10.9	28.1	23.2
3. 2nd Cleaner Tailing	4.37	0.20	0.85	0.81	0.2	7.0	4.3
4. 1st Cleaner Tailing	11.29	0.23	2.42	2.11	0.5	51.5	29.2
5. Rougher Tailing	78.88	0.12	0.018	0.08	2.0	2.7	7.8
Head (calculated)	100.00	4.69	0.53	0.81	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	5.46	83.5	3.76	8.76	97.3	38.8	58.7
Products 1 to 3	9.83	46.5	2.47	5.22	97.5	45.8	63.0
Products 1 to 4	21.12	21.7	2.44	3.56	98.0	97.3	92.2

Test No. 5

Purpose: To conduct a gravity concentration test, followed by the flotation of the table tailings.

Procedure: The ground pulp was passed over a laboratory Wilfley shaking table. The middling was recirculated during the processing stages. The concentrate was collected for assay. The tailing was thickened for flotation test.

Feed: 2000 grams minus 10 mesh

Grind: 20 minutes per 2000 g sample in a laboratory ball mill at 65% solids.

Flotation Test

Purpose: To conduct a flotation test on the table tailings.

Procedure: Roughing was conducted in three 5 minute stages, followed by three cleaning stages.

Feed: 1930 grams Wilfley table tailings.

Grind: nil

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes	
	AX350	AF208	MIBC	Cond.	Froth
Rougher (1)	20	20	5	1	5
(2)	15	15	-	1	5
(3)	10	10	-	1	5
1st Cleaner	-	-	-	-	4
	10	10	5	1	3
2nd Cleaner	-	-	-	-	3
	5	5	5	1	2
3rd Cleaner	-	-	-	-	3

Stage	Rougher	1st Cleaner	2nd + 3rd Cleaners
Flotation Cell	Denver 1000 g D-1	Denver 500 g D-1	Denver 250 g D-1
Speed: r.p.m.	1800	1500	1200

Test No. 5 - Continued

Metallurgical Results

Product	Weight %	Assays, %, g/t			% Distribution		
		Au	As	S	Au	As	S
1. Table Concentrate	3.94	187.0	7.21	8.48	91.2	55.7	42.4
2. 3rd Cleaner Conc.	1.89	31.2	4.60	13.3	7.3	17.1	31.9
3. 3rd Cleaner Tailing	1.67	0.86	5.23	4.59	0.2	17.1	9.7
4. 2nd Cleaner Tailing	1.43	0.24	0.42	0.67	0.1	1.2	1.2
5. 1st Cleaner tailing	8.91	0.15	0.36	0.75	0.1	6.3	8.5
6. Rougher Tailing	82.16	0.11	0.016	0.06	1.1	2.6	6.3
Head (calculated)	100.00	8.08	0.51	0.79	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	5.83	136.5	6.36	10.1	98.5	72.8	74.3
Products 1 to 3	7.50	106.3	6.11	8.83	98.7	89.9	84.0
Products 1 to 4	8.93	89.3	5.20	7.52	98.8	91.1	85.2
Products 1 to 5	17.84	44.8	2.78	4.14	98.9	97.4	93.7
Products 2 to 5	13.9	4.47	1.53	2.91	7.7	41.7	51.3

Test No. 6

Purpose: To conduct a flotation test on the ground ore followed by the cyanidation of the cleaner concentrate.

Procedure: Roughing was conducted in three 5 minute stages, followed by two cleaning stages.

Feed: 2000 grams minus 10 mesh feed.

Grind: 20 minutes in a lab ball mill at 65% solids.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes		pH
	AX350	AF208	MIBC	Cond.	Froth	
Rougher (1)	20	20	5	1	5	8.2
(2)	15	15	-	1	5	-
(3)	10	10	5	1	5	-
1st Cleaner	-	-	-	-	4	-
	10	10	5	1	3	-
2nd Cleaner	-	-	-	-	3	-
	5	5	5	1	2	-

Stage	Rougher	1st Cleaner	2nd Cleaner
Flotation Cell	Denver	Denver	Denver
	1000 g D-1	500 g D-1	500 g D-1
Speed: r.p.m.	1800	1500	1500

Metallurgical Results - Flotation

Product	Weight %	Assays, g/t Au	% Distribution Au
1. 2nd Cleaner Conc.	6.08	54.3	85.9
2. 2nd Cleaner Tailing	2.61	16.8	11.4
3. 1st Cleaner Tailing	12.30	0.47	1.5
4. Rougher Tailing	79.01	0.06	1.2
Head (calculated)	100.00	3.85	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.69	43.0	97.3
Products 1 to 3	20.99	18.1	98.8

Test No. 6 - Continued

Purpose: To conduct a cyanidation test on the second cleaner concentrate.

Procedure: The sample was pulped with water at 33% solids in a 2.5 litre bottle. The pH was adjusted to a pH >11.0 with $Ca(OH)_2$, and the sample was preaerated on rolls for 24 hours. The pulp was filtered and washed three times with water. The sample was repulped at 33% solids and the cyanidation was carried out on rolls in 2 x 24 hour stages with the solution being changed after each stage. Between each stage the pulp was filtered and the residue washed three times with water. The residue was then repulped with fresh cyanide solution and the test continued.

Feed: approx. 130 g 2nd cleaner concentrate.

Solution Volume: 260 mL Pulp Density: 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range: 11 with $Ca(OH)_2$

Grind: 20 minutes per 2000 grams in a lab ball mill at 65% solids.

Reagent Balance:

Time, Hours	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO	From	To
Preaeration:										
0 - 24	-	0.50	-	0.38	-	0.08	-	0.30	12.2	11.4
Cyanidation:										
Stage 1:										
0 - 1	0.27	0.06	0.26	0.05	0.20	0.03	0.06	0.02	11.4	11.3
1 - 7	0.06	-	0.06	-	0.26	0.03	0.00	0.00	11.3	11.3
7 - 17	-	-	-	-	0.26	0.02	0.00	0.01	11.3	11.1
17 - 24	-	-	-	-	0.25	0.01	0.01	0.01	11.1	11.0
Cyanidation:										
Stage 2:										
0 - 14.5	0.27	0.11	0.26	0.08	0.26	0.03	0.00	0.05	11.5	11.1
14.5 - 24	-	-	-	-	0.25	0.01	0.01	0.02	11.1	10.9
Total	0.60	0.67	0.58	0.51	0.50	0.10	0.08	0.41		

Reagent Consumption (kg/t of cyanide feed): NaCN: 0.66
CaO: 3.39

Test No. 6 - Continued

Metallurgical Results - Cyanidation

Product	Amount	Assays, mg/L, g/t Au	% Distribution Au
1. 24 h Preg. + Wash	780 mL	7.46	88.6
2. 48 h Preg. + Wash	820 mL	0.82	10.2
3. Cyanide Residue	121 g	0.67	1.2
Head (calculated)	121 g	54.3	100.0

Calculated Grades and Recoveries

Products 1 plus 2	1600 mL	4.06	98.8

Metallurgical Results - Overall

Product	Weight		Assays, %, mg/L, g/t			% Distribution		
	Amt	%	Au	As	S	Au	As	S
1. 24 h Preg. + Wash	780 mL	-	7.46	-	-	76.0	-	-
2. 48 h Preg. + Wash	820 mL	-	0.82	-	-	8.8	-	-
3. CN Residue	121.0 g	6.1	0.67	5.17	8.93	1.1	58.1	68.8
4. 2nd Cl. Tailing	52.0 g	2.6	16.8	3.42	2.15	11.4	16.4	7.1
5. 1st Cl. Tailing	244.8 g	12.3	0.47	0.92	1.10	1.5	20.9	17.1
6. Rougher Tailing	1572.9 g	79.0	0.06	0.032	0.07	1.2	4.6	7.0
Head (calculated)	1990.7 g	100.0	3.85	0.54	0.79	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	1600 mL	-	-	-	-	84.8	-	-
Products 1 to 3	121.0 g	6.1	54.3	5.17	8.93	85.9	58.1	68.8
Products 1 to 4	173.0	8.7	43.0	4.65	6.90	97.3	74.5	75.9
Products 1 to 5	417.8	21.0	18.1	2.46	3.50	98.8	95.4	93.0

Test No. 7

Purpose: To repeat Test 5.

Procedure: As for Test 5.

Feed: 2000 grams.

Grind: 20 minutes per 2000 g sample in a lab ball mill at 65% solids.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes		pH
	AX350	AF208	MIBC	Cond.	Froth	
Rougher (1)	20	20	5	1	5	8.0
(2)	15	15	-	1	5	-
(3)	10	10	5	1	6	-
1st Cleaner	-	-	5	-	5	-
	10	10	5	1	3	-
2nd Cleaner	-	-	5	-	3	-
	5	5	-	1	2	-
3rd Cleaner	-	-	-	-	3	-

Stage	Rougher	1st Cleaner	2nd Cleaner	3rd Cleaner
Flotation Cell	Denver 1000 g D-1	Denver 500 g D-1	Denver 500 g D-1	Denver 250 g D-1
Speed: r.p.m.	1800	1500	1500	1200

Test No. 7 - Continued

Metallurgical Results

Product	Weight %	Assays, %, g/t			% Distribution		
		Au	As	S	Au	As	S
1. Table Concentrate	7.3	23.8	5.06	6.34	43.6	69.6	55.5
2. 3rd Cleaner Conc.	0.7	277.	11.4	24.6	48.6	15.1	20.6
3. 3rd Cleaner Tailing	0.8	4.16	4.88	7.50	0.8	7.4	7.2
4. 2nd Cleaner Tailing	1.4	1.17	0.66	1.32	0.4	1.7	2.2
5. 1st Cleaner Tailing	7.7	2.53	0.099	0.29	4.9	1.4	2.7
6. Rougher Tailing	82.1	0.08	0.031	0.12	1.7	4.8	11.8
Head (calculated)	100.0	3.99	0.53	0.83	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.0	46.0	5.61	7.94	92.2	84.7	76.1
Products 1 to 3	8.8	42.2	5.55	7.90	93.0	92.1	83.3
Products 1 to 4	10.2	36.5	4.88	7.00	93.4	93.8	85.5
Products 1 to 5	17.9	21.9	2.82	4.11	98.3	95.2	88.2
Products 2 to 5	10.6	20.6	1.28	2.57	54.7	25.6	32.7

Test No. 8

Purpose: To determine free gold in the sample.

Procedure: The sample was ground, filtered and divided into four equal fractions. The samples were pulped with water in 2 litre bottles. Mercury, sodium hydroxide and xanthate 350 were added. The amalgamation was carried out on rolls for 2 hours. The mercury was collected by elutriation in 2 litre separatory funnels. The amalgam tails were combined and reserved for flotation.

Feed: 2000 grams minus 10 mesh.

Grind: 30 minutes/2 kg at 65 % solids in a lab ball mill.

Comments: No flowering of mercury occurred - good separation.

Flotation:

Purpose: To float the amalgam tailing.

Procedure: As outlined below.

Feed: Combined amalgam tailings, Test No. 8.

Grind: nil.

Conditions:

Stage	Reagents Added, grams/tonne				Time, minutes		pH
	H_2SO_4	AX350	AF208	MIBC	Cond.	Froth	
Rougher	1500	-	-	-	5	-	11.6 - 7.4
	-	20	20	10	2	5	7.6
	-	15	15	5	2	5	-
	-	10	10	5	2	5	-
1st Cleaner	-	-	-	-	1	3	8.2
	-	10	10	5	2	5	-
	-	10	10	5	2	5	-
2nd Cleaner	-	-	-	-	1	3	8.2
	-	5	5	5	2	3	-

Comments: A third stage was added to the 1st cleaner because some sulphide remained in tailing.

Stage	Rougher	Cleaner
Flotation Cell	1000 g D-1	500 g D-1
Speed: r.p.m.	1800	1200

Test No. 8 - Continued

Metallurgical Results

Product	Weight %	Assays, g/t, mg Au	% Distribution Au
1. Amalgam	-	24.850	95.6
2. Cleaner Concentrate	4.5	11.3	3.9
3. 2nd Cleaner Tailing	5.1	0.39	0.1
4. 1st Cleaner Tailing	6.9	0.17	0.1
5. Rougher Tailing	83.5	0.05	0.3
Head (calculated)	100.0	13.1	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.5	290.5	99.5
Products 1 to 3	9.6	136.9	99.6
Products 1 to 4	16.5	79.3	99.7
Products 2 to 4	16.5	3.27	4.1

Test No. 9

Purpose: To recover the free gold from the sample by gravity separation.

Procedure: The sample was ground and passed over a Wilfley table. The concentrate and tailing were collected. The concentrate and tailing were collected. The concentrate was cleaned on a Mozley table. The table tails were combined and reserved for flotation.

Feed: 2000 grams minus 10 mesh sample.

Grind: 10 minutes/2 kg at 65 percent solids in a lab ball mill.

Flotation:

Purpose: To float the gravity tailings.

Procedure: As outlined below.

Feed: Gravity tails. from Test No. 1.

Grind: nil.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes		pH
	AX350	AF208	MIBC	Cond.	Froth	
Rougher	20	20	10	2	5	7.9
	15	15	5	2	5	-
	10	10	5	2	5	-
1st Cleaner	-	-	-	1	3	8.1
	10	10	5	2	5	-
	10	10	5	2	5	-
2nd Cleaner	-	-	-	1	3	8.3
	5	5	5	2	3	-

Comments: A third stage was added to the 1st cleaner because some sulphides remained in tailing.
At the completion of the third stage a small amount of sulphides were floating but little weight was left.

Stage	Rougher	Cleaner
Flotation Cell	1000 g D-1	500 g D-1
Speed: r.p.m.	1800	1200

Test No. 9 - Continued

Metallurgical Results

Product	Weight %	Assay, g/t Au	% Distribution Au
1. Mozley Concentrate	0.2	3505.	86.6
2. Cleaner Concentrate	3.3	30.3	12.3
3. 2nd Cleaner Tailing	4.2	0.51	0.3
4. 1st Cleaner Tailing	5.6	0.12	0.1
5. Rougher	86.7	0.07	0.7
Head (calculated)	100.0	8.10	100.0

Calculated Grades and Recoveries

Products 1 plus 2	3.5	228.9	98.9
Products 1 to 3	7.7	104.3	99.2
Products 1 to 4	13.3	60.4	99.3
Products 2 to 4	13.1	7.85	12.7

Screen Analysis

Rougher Tailing

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 14	2.3	2.3	97.7
20	2.3	4.6	95.4
28	3.3	7.9	92.1
35	4.3	12.2	87.8
48	8.1	20.3	79.7
65	9.0	29.3	70.7
100	9.1	38.4	61.6
150	9.1	47.5	52.5
200	7.5	55.0	45.0
270	6.6	61.6	38.4
400	6.3	67.9	32.1
- 400	32.1	100.0	-
Total	100.0	-	-

Test No. 10

Purpose: To conduct a 20 kg test by the gravity concentration and the flotation of the gravity tailing.

Sample: 20 kg minus 10 mesh.

Grind: 20 minutes in a ball mill at 65% solids.

Procedure: The ground slurry was passed over a Wilfley table. The table concentrate was re-treated with a Mozley table to obtain a small weight concentrate. Both Wilfley table and Mozley table tailings were combined for the flotation test.

Observations: There are several coarse gold particles visibly present in the Mozley concentrate. A large gold particle, measured 2 x 3 x 3 mm and weighing 75 mg, was cleaned out from the circulating pump.

Flotation:

Purpose: To conduct a flotation test on the gravity concentration tailing.

Feed: The combined gravity concentration tailings.

Grind: nil

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes		pH
	AX350	AF208	MIBC	Cond.	Froth	
Rougher (1)	20	20	5	3	5	8.0
(2)	15	15	5	1	5	-
(3)	10	10	5	1	5	-
1st Cleaner	-	-	-	-	3	-
	5	5	5	1	3	-
2nd Cleaner	-	-	-	-	3	-
	5	5	5	1	3	-
3rd Cleaner	-	-	-	-	3	-
	5	5	5	1	2	-

Stage	Ro + 1st Cl.	2nd Cleaner	3rd Cleaner
Flotation Cell	Agitair Cell	Denver 2000 g D-2	Denver 1000 g D-2
Speed: r.p.m.	1800	1800	1500

Test No. 10 - Continued

Metallurgical Results

Product	Weight %	Assays, g/t Au	% Distribution Au
1. Mozley Table Conc.	0.03	29191.	89.7
2. 3rd Cleaner Conc.	2.64	31.1	8.4
3. 3rd Cleaner Tailing	2.93	2.39	0.7
4. 2nd Cleaner Tailing	2.47	0.90	0.2
5. 1st Cleaner Tailing	9.00	0.87	0.8
6. Rougher Tailing	82.93	0.02	0.2
Head (calculated)	100.00	9.76	100.0

Calculated Grades and Recoveries

Products 1 plus 2	2.67	358.7	98.1
Products 1 to 3	5.60	172.3	98.8
Products 1 to 4	8.07	119.8	99.0
Products 1 to 5	17.07	57.1	99.8
Products 2 to 5	17.04	5.82	10.1
Products 2 to 6	99.97	1.01	10.3

Screen Analysis

Rougher Tailing

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 65	6.2	6.2	93.8
100	8.8	15.0	85.0
150	12.8	27.8	62.2
200	12.4	40.2	59.8
270	10.8	51.0	49.0
400	10.0	61.0	39.0
- 400	39.0	100.0	-
Total	100.0	-	-

LAKEFIELD RESEARCH
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